reference method analytical procedure is out of control. Corrective action must be taken to determine the source of the error(s) (e.g., calibration standard discrepancies, extraction problems, etc.) and the reference method and audit sample determinations must be repeated according to paragraph (c) of this section, or the entire test procedure (starting with paragraph (a) of this section) must be repeated.

(h) *Test for comparability.* (1) For each filter pair, calculate all nine possible percent differences (D) between the reference and candidate methods, using all nine possible combinations of the three determinations (A, B, and C) for each method, as:

Equation 6

$$D_{in} = \frac{C_{ij} - R_{ik}}{R_{ik}} \times 100\%$$

where:

i is the filter number, and n numbers from 1 to 9 for the nine possible difference combinations for the three determinations for each method (j = A, B, C, candidate; k = A, B, C, reference).

(2) If none of the percent differences (D) exceeds ±20 percent, the candidate method passes the test for comparability.

(3) If one or more of the percent differences (D) exceeds ±20 percent, the candidate method fails the test for comparability.

(i) The candidate method must pass both the precision test (paragraph (f) of this section) and the comparability test (paragraph (h) of this section) to qualify for designation as an equivalent method.

§ 53.34 Test procedure for methods for PM_{10} and $PM_{2.5}$.

(a) *Collocated measurements.* Set up three reference method samplers collocated with three candidate method samplers or analyzers at each of the number of test sites specified in table C–4 of this subpart. At each site, obtain as many sets of simultaneous PM_{10} or $PM_{2.5}$ measurements as necessary (see paragraph (c)(3) of this section), each set consisting of three reference method and three candidate method measurements, all obtained simultaneously. For $PM_{2.5}$ candidate Class II equivalent methods, at least two collocated PM_{10} reference method samplers are also required to obtain $PM_{2.5}/PM_{10}$ ratios for each sample set. Candidate PM_{10} method measurements shall be 24-hour integrated measurements; $PM_{2.5}$ measurements may be either 24- or 48-hour integrated measurements. All collocated measurements in a sample set must cover the same 24- or 48-hour time period. For samplers, retrieve the samples promptly after sample collection and analyze each sample according to the reference method or candidate method, as appropriate, and determine the PM_{10} or $PM_{2.5}$ concentration in µg/m³. If the conditions of § 53.30(d)(4) apply, collect sample sets only with the three reference method samplers. Guidance for quality assurance procedures for $PM_{2.5}$ methods is found in section 2.12 of the Quality Assurance Handbook (reference 6 of appendix A to subpart A of this part).

(b) *Sequential samplers.* For sequential samplers, the sampler shall be configured for the maximum number of sequential samples and shall be set for automatic collection of all samples sequentially such that the test samples are collected equally, to the extent possible, among all available sequential channels or utilizing the full available sequential capability.

(c) *Test for comparability and precision.* (1) For each of the measurement sets, calculate the average PM_{10} or $PM_{2.5}$ concentration obtained with the reference method samplers:

Equation 7

$$\overline{R}_j = \frac{\sum_{i=1}^{3} R_{ij}}{3}$$

where:

R denotes results from the reference method;
i is the sampler number; and
j is the set.

(2)(i) For each of the measurement sets, calculate the precision of the reference method PM_{10} or $PM_{2.5}$ measurements as:

Equation 8

$$P_j = \sqrt{\frac{\sum_{i=1}^{3} R_{ij}^2 - \frac{1}{3}\left(\sum_{i=1}^{3} R_{ij}\right)^2}{2}}$$

If the corresponding $\bar{R}_j$ is below:

80 µg/m³ for PM_{10} methods.
40 µg/m³ for 24-hour $PM_{2.5}$ at single test sites for Class I candidate methods.
40 µg/m³ for 24-hour $PM_{2.5}$ at sites having $PM_{2.5}/PM_{10}$ ratios >0.75.
30 µg/m³ for 48-hour $PM_{2.5}$ at single test sites for Class I candidate methods.
30 µg/m³ for 48-hour $PM_{2.5}$ at sites having $PM_{2.5}/PM_{10}$ ratios >0.75.
30 µg/m³ for 24-hour $PM_{2.5}$ at sites having $PM_{2.5}/PM_{10}$ ratios <0.40.
20 µg/m³ for 48-hour $PM_{2.5}$ at sites having $PM_{2.5}/PM_{10}$ ratios >0.75.

(ii) Otherwise, calculate the precision of the reference method PM_{10} or $PM_{2.5}$ measurements as:

Equation 9

$$Rp_j = \frac{1}{\bar{R}_j}\sqrt{\frac{\sum_{i=1}^{3} R_{ij}^2 - \frac{1}{3}\left(\sum_{i=1}^{3} R_{ij}\right)^2}{2}} \times 100\%$$

(3) If $\bar{R}_j$ falls outside the acceptable concentration range specified in table C–4 of this subpart for any set, or if P_j RP_j as applicable, exceeds the value specified in table C–4 of this subpart for any set, that set of measurements shall be discarded. For each site, table C–4 of this subpart specifies the minimum number of sample sets required for various conditions, and §53.30(b)(5) specifies the $PM_{2.5}/PM_{10}$ ratio requirements applicable to Class II candidate equivalent methods. Additional measurement sets shall be collected and analyzed, as necessary, to provide a minimum of 10 acceptable measurement sets for each test site. If more than 10 measurement sets are collected that meet the above criteria, all such measurement sets shall be used to demonstrate comparability.

(4) For each of the acceptable measurement sets, calculate the average PM_{10} or $PM_{2.5}$ concentration obtained with the candidate method samplers:

Equation 10

$$\bar{C}_j = \frac{\sum_{i=1}^{3} C_{ij}}{3}$$

where:

C denotes results from the candidate method;
i is the sampler number; and
j is the set.

(5) For each site, plot the average PM_{10} or $PM_{2.5}$ measurements obtained with the candidate method (R_j) against the corresponding average PM_{10} or $PM_{2.5}$ measurements obtained with the reference method (R_j). For each site, calculate and record the linear regression slope and intercept, and the correlation coefficient.

(6) If the linear regression parameters calculated under paragraph (c)(5) of this section meet the values specified in table C–4 of this subpart for all test sites, the candidate method passes the test for comparability.

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TABLE C–1 TO SUBPART C OF PART 53—TEST CONCENTRATION RANGES, NUMBER OF MEASUREMENTS REQUIRED, AND MAXIMUM DISCREPANCY SPECIFICATION

Pollutant	Concentration Range Parts per Million	Simultaneous Measurements Required				Maximum Discrepancy Specification, Parts per Million
		1–hr		24–hr		
		First Set	Second Set	First Set	Second Set	
Ozone	Low 0.06 to 0.10	5	6			0.02
	Med 0.15 to 0.25	5	6			.03
	High 0.35 to 0.45	4	6			.04
	Total	14	18			
Carbon Monoxide	Low 7 to 11	5	6			1.5
	Med 20 to 30	5	6			2.0